How to estimate the pre-entry mass of meteoroids at the source of large fireballs

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Abstract. Cosmic objects are impacting the Earth's atmosphere on a daily basis. Due to their small size, these meteoroids can not be seen before interacting with the air particles. Thus, to better constrain the size of an impactor, we need calibrated multi-detector observations, combined with state of the art theoretical models. These detectors range from cameras and radio antennas [1], to infrasound arrays, and seismic detectors, which measure the airwave effects of large events. In this study we explore several published techniques of measuring the pre-entry mass of meteoroids with well-known trajectory (also a subject of meteorite recoveries), at the source of ton TNT-scale atmospheric impacts [2]. On this scale, the fireball is less likely to cause an airwave signal detectable on multiple specialized stations, or the estimation methods carry high uncertainty [3, 4]. Thus, in this analysis we focus on the optical energy signature of the objects. Most of the objects did have an estimate of the radiated light, hence, this was obtained via digitization from the published light curve. Next, the given velocity and mass, has allowed to derive a relation between the radiated light and the object's kinetic energy. The result represents a (more accurate) continuation of the previous relation presented by [5], for the smaller, more frequent fireballs. This, in turn will help cross-calibrate other methods of estimating the source energy, allowing to further constrain the size-frequency distribution of atmospheric impacts.

Keywords: techniques: photometric · meteorites, meteors, meteoroids · asteroids: general.

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